DOE/BC/15191-5

QUARTERLY TECHNICAL PROGRESS REPORT

FOR THE PERIOD ENDING

JUNE 30, 2001

For DOE Grant Entitled

"ENHANCED OIL RECOVERY WITH DOWNHOLE VIBRATION STIMULATION IN OSAGE COUNTY, OKLAHOMA"

Contract Number:	**DE-FG26-00BC15191**
Contractor:	**Oil & Gas Consultants International, Inc.** **4111 So. Darlington Suite 700** **Tulsa, Oklahoma**
Contract Date:	**July 13, 2000**
Anticipated Completion:	**November 12, 2001**
Government Award:	**$525,000 (Current Year)**
Principal Investigators:	**J. Ford Brett** **Robert V. Westermark**
Project Manager:	**Virginia Weyland** **National Petroleum Technology Office**
Reporting Period:	**April 1, 2001 – June 30, 2001**

Disclaimer

Abstract

This Technical Quarterly Report is for the reporting period April 1, 2001 to June 30, 2001. The report provides details of the work done on the project entitled "Enhanced Oil Recovery with Downhole Vibration Stimulation in Osage County Oklahoma".

The project is divided into nine separate tasks. Several of the tasks are being worked on simultaneously, while other tasks are dependent on earlier tasks being completed.

Drilling the project's new well has been delayed due to the lack of drilling rig availability in northeastern Oklahoma. In addition to the delay caused by the shortage of drilling rigs, the field for the pilot test has been changed. The field where the test will be conducted is the North Burbank Unit (NBU), the largest field in Osage County and a mature waterflood.

Calumet Oil Company, the operator of the NBU, has agreed to participate in the project by providing the North Burbank Unit as the field test area.

The 7-inch Downhole Vibration Tool (DHVT) has been built and is ready for initial surface testing.

Presentation of the material from SPE Paper 67303[1] (delivered at the OK City Production Operations Symposium, March 29, 2001) was given at the NPTO Office of the DOE April 19, 2001, at the invitation of Ginny Weyland, contract officer.

Updated material was presented to the Oklahoma Geologic Survey / DOE Annual Workshop in Oklahoma City May 8,9 2001.

A presentation was given at the final LANL Seismic Stimulation Project Meeting April 25 at Berkeley; co-sponsored by Las Alamos National Lab and Lawrence Berkeley National Lab.

The material was also presented, by invitation, at the Petroleum Technology Transfer Council / Marcus Evans conference on Maximizing Recovery 2001 June 25-26, 2001 in Houston. This was one of four presentations given on seismic stimulation efforts by different organizations given to managers of technology development for operating companies.

A technical paper abstract has been accepted for the ASME/ETCE conference (Feb 2002) Production Technology Symposium.

A one-day SPE sponsored short course which is planned to cover seismic stimulation efforts around the world, will be offered at the SPE/DOE Thirteenth Symposium on Improved Oil Recovery in Tulsa, OK, April 13-17, 2002.

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Introduction

The objective of this project is to demonstrate the impact of downhole vibration stimulation on production rates in a mature waterflood field. Oil and Gas Consultants International, Inc. (OGCI) will manage the project in close cooperation with the Osage Tribe as the tests will be conducted in Osage County, Oklahoma, the mineral estate of the Osage Tribe. Calumet Oil Company operates the field. Phillips Petroleum Company will contribute their proprietary vibration core analysis of cores recovered from the pilot test area.

To achieve the project objectives, the work has been divided into nine tasks, some are concurrent, while other tasks rely on completion of previous steps. The initial task is a review of the North Burbank Unit field operated by Calumet Oil Company, in Osage County, Oklahoma, to determine the appropriate pilot test area. Once the pilot test area is selected, Calumet Oil Company will maintain current field operations, collecting base-line production and injection data. The team will then determine where within the pilot test area to optimally locate the vibration test well. With the location determined, the test well will be drilled, cored, logged and 7-inch production casing run and cemented.

In a parallel effort, OGCI will be designing, building, and testing a new version of the downhole vibration tool based on their patented whirling orbital vibrator. With the field test tool built to run in 7-inch casing, duration testing of the downhole tool and surface power source will be conducted.

After the core is recovered, Phillips Petroleum Company will be conducting laboratory tests utilizing their proprietary sonic core apparatus to determine fluid flow response to a range of vibration frequencies. These results, in turn, will allow final adjustments to the frequency generation mechanisms of the downhole vibration tool.

One or more offset wells, in the area adjacent to the vibration test well, will be equipped with downhole geophones to determine strength of signal and if the producing formation has a dominant frequency response. Surface geophones will also be set out and arranged to pick up the signal generated by the downhole vibration tool.

The downhole vibrator will be installed in the test well. Monitoring the production and injection for the pilot test area will continue. As the frequency of the downhole tool is changed, the recording of seismic signals, both on the surface and downhole, will also be conducted. The results of the data collection will be a matrix of varying vibration stimulation conditions corresponding to changes in production and injection fluid rates and seismic responses.

In addition to required DOE reports, the results of the downhole vibration stimulation will be prepared and delivered using several venues. Technical papers will be submitted to the Society of Petroleum Engineers and other professional organizations. Workshops are planned to be held in conjunction with the PTTC for operators in Osage County and surrounding areas. A dedicated technical session on vibration stimulation will be offered at the 13th SPE/DOE IOR Symposium 2002, bringing together the world’s experts in this emerging technology. The final task will be to close out the project.

Executive Summary

Contract Status:

No change to the contract status occurred during this reporting period.

Financial status:

During this quarter $64,699 has been dispersed with an additional $135,750 committed for work in progress.

Schedule Status:

The project schedule had slipped approximately seven months primarily due to changing operators and moving to a different field to conduct the test. Currently, the vibration stimulation test well is scheduled to be drilled July 2001. Other project critical path activities are being conducted simultaneously.

Technical Progress:

Drilling the Vibration Stimulation Test Well

The vibration stimulation test will be conducted at the NBU field in Osage County, OK. See Fig. 1 on page 4. The pilot test area is located in Section 8 T26N R6E, please refer to Fig. 2 on the following page. The vibration stimulation test well location is 2560 ft FWL and 510 ft FSL of NW/4 of Section 8, known as Tract 111. The Well number is Well 111-W-27.

The surface of the area can been seen on the composite USGS Topographic map found in Fig. 3.

Directions to the test area can be found on the maps in Figs 4a, 4b and 4c

Building the Downhole Vibration Tool

OGCI has built the 7-inch field test version of the downhole vibration tool (DHVT). In the course of improving the present tool design, a novel method of constructing the tool has been implemented. An invention disclosure was given to OGCI’s patent attorneys and we plan to apply for a patent.

The notice of invention disclosure to DOE patent attorneys per the grant contract was dated June 28, 2001. Please find information in Appendix A concerning the invention disclosure.

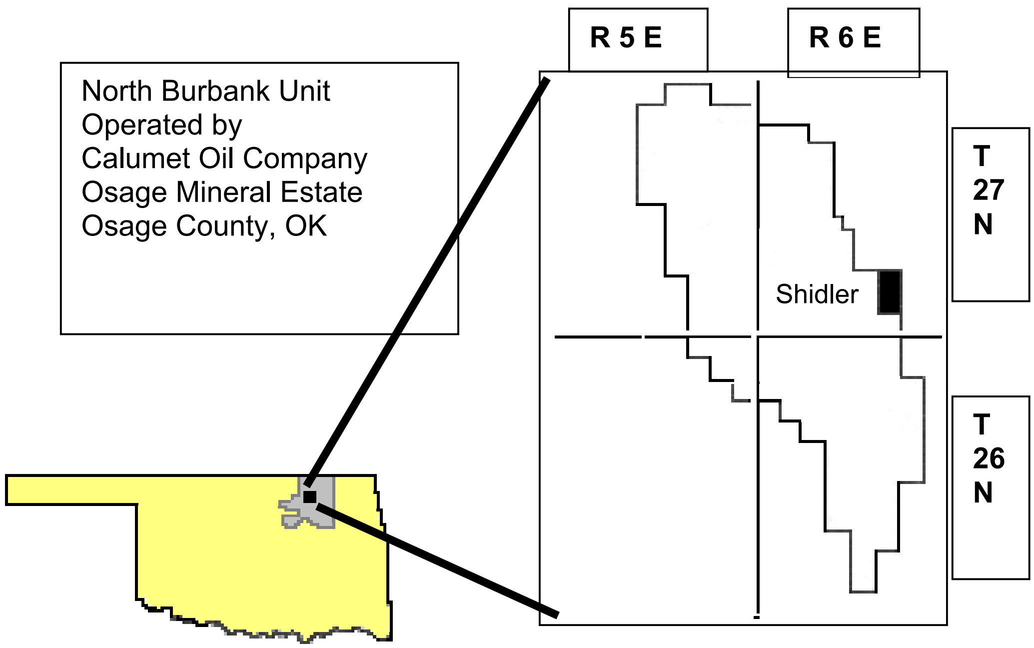


Figure 1 Location of North Burbank Unit Field, Osage County, OK.

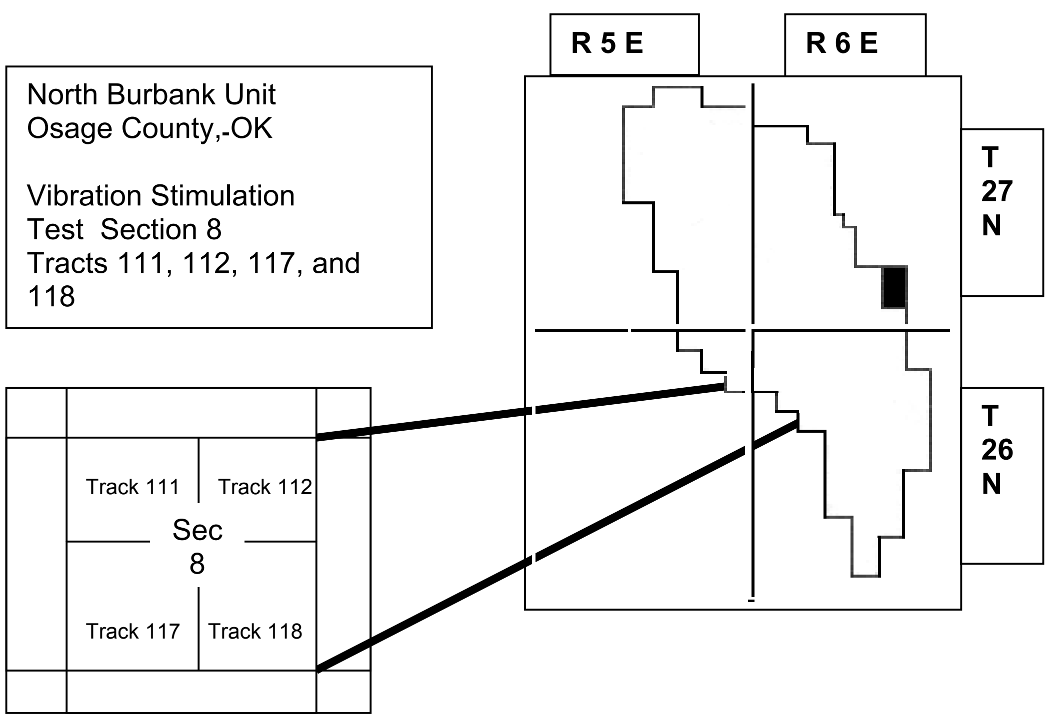


Figure 2 Section 8 T26N R 6E North Burbank Unit Field, Osage County, OK.

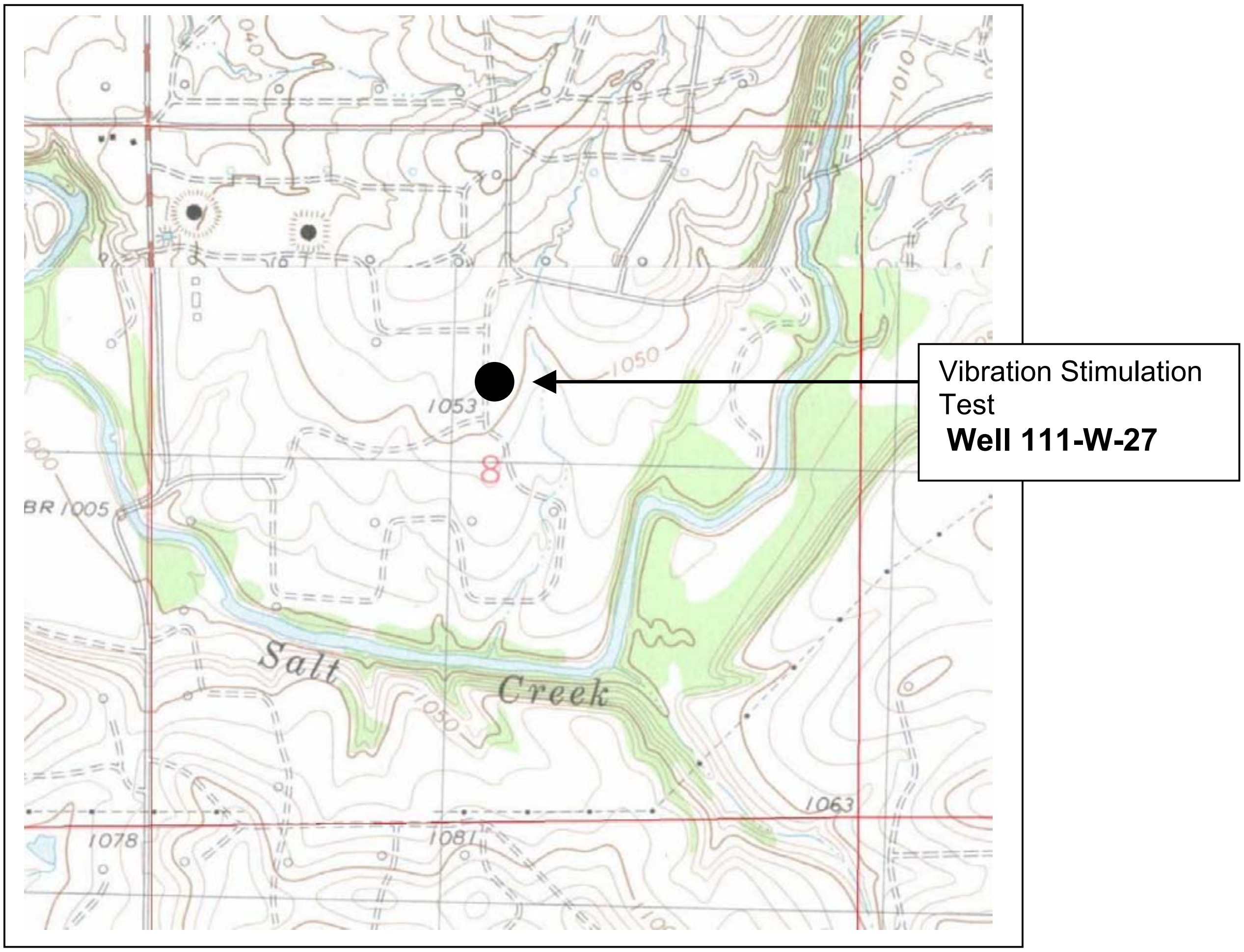


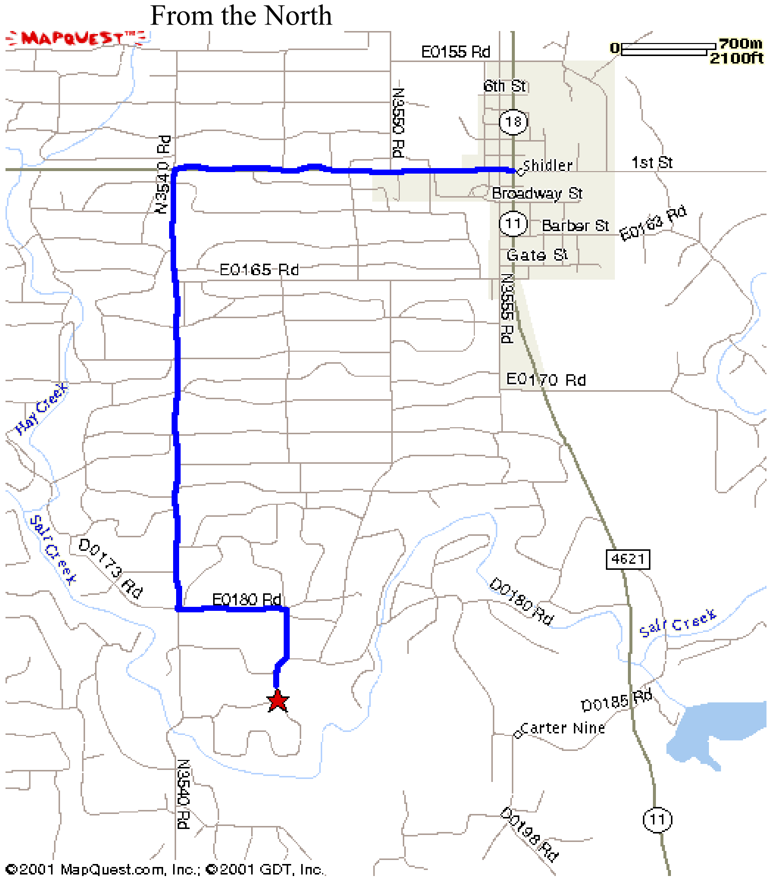
Figure 3 Section 8 T26N R 6E USGS Topographic Map, Osage County, OK.

Directions to Vibration Stimulation Well Location
North Burbank Tract 111 Section 8 Township 25N Range 6E

The site is located, as the crow flies, 3 miles south west of the town of Shidler, Oklahoma. To get to Shidler take Highway 18 north until it meets Highway 11 running east and west. This is near the center of Shidler. There are two ways to get to the location, one from the north (suggested route) coming in from Shidler and Highway 11, and one from the south (alternate route) coming in from highway 18. Both ways are explained on the maps and in the paragraphs below.

Figure 4a Highway map to vibration stimulation test site.

From the North

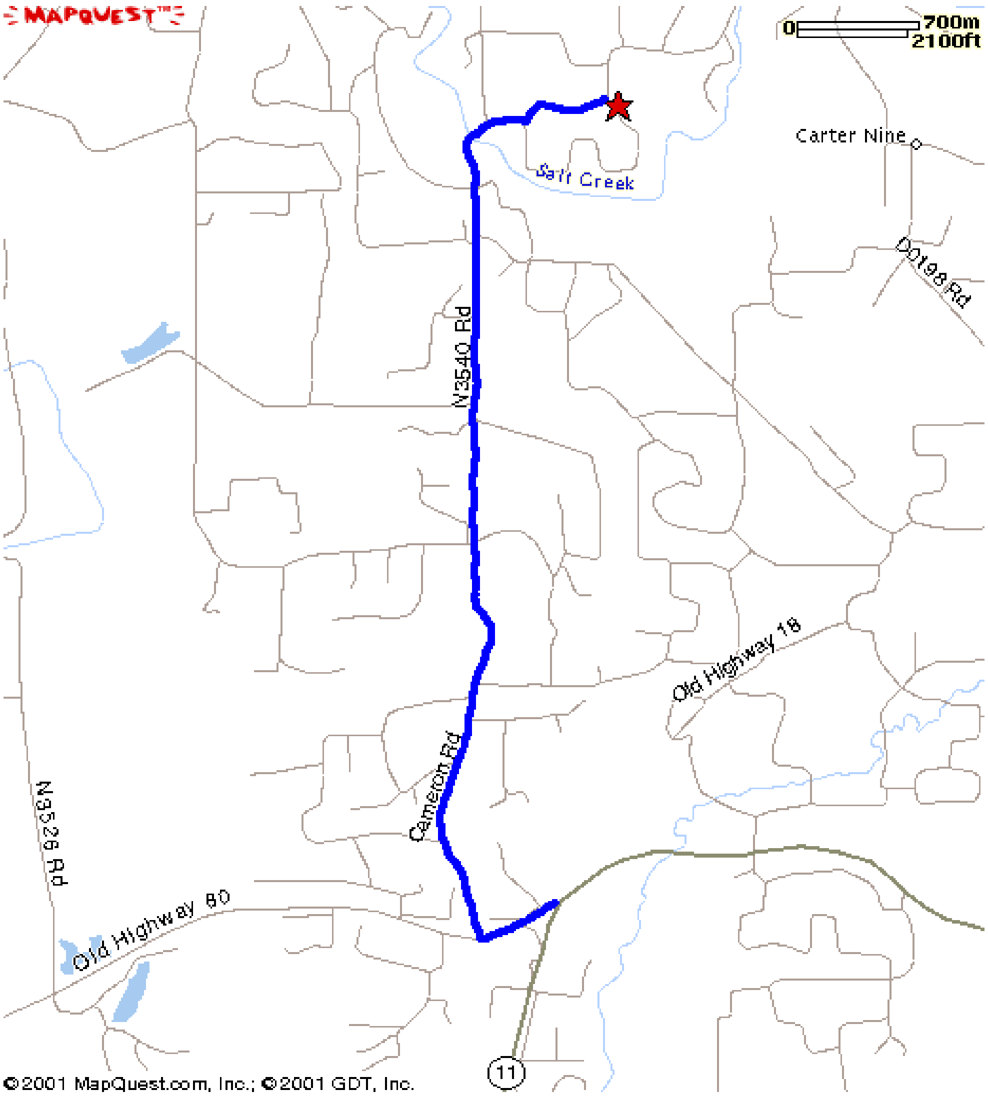


Suggested Route

From the intersection of Highway 18 and Highway 11 in Shidler, go west on Highway 11 approximately 1 ½ miles to Cameron Road. Cameron is a paved road. Go south on Cameron Road approximately 2 miles to CR4250 (labeled E0180 on map) a street sign is at the intersection. This road is a gravel road. Go East on CR4250 approximately 1/2 mile and turn south onto another gravel road. Take this road south approximately 1/2 mile and the site will be on the east side of the road, just north west of Tank Battery 118. The site is located in the south east corner of Tract 111 in Section 8, Township 25N, and Range 6E in the North Burbank Oil Fields.

Figure 4 b Northern route using lease roads to vibration stimulation test well.

From the South



Alternate Route

To get to the location from Highway 18 running north from Highway 60: Go west on Old Highway 80 to Cameron Road. Take Cameron Road north until you cross Salt Creek and take the first right. Go east on this gravel road and at the Y take the road to the left. Follow this road east and it will take you to the site, which is just north west of Tank Battery 118.

Figure 4 c Southern route using lease roads to vibration stimulation test well.

Experimental

DESIGN, MANUFACTURE, AND INITIAL SHOP TESTING

The design and manufacturing process for the 7-inch Downhole Vibration Tool (DHVT) was completed in mid May 2001. The testing process began with the first running of the tool on May 24, 2001.

Testing has been conducted at Machine Engineering in Tulsa with an excavator used to drive the hydraulic motor.

The second test run was on June 15, 2001. The first and second tests were done without the use of accelerometers therefore no quantitative operational data was taken. There were, however, observations taken of all components to see if there was any unexpected wear or problematic galling of materials after a run of from 50-150 RPM.

After changes were made to the compression components of the tool and it was run a second time on June 15, there were some signs of galling due to improper compression.

This problem was investigated in the third test of the tool, which now had instrumentation to record rotations and frequency. The third test on June 22 provided valuable data about the frequency of the tool at different speeds and, observations made on parts after the tool was run helped lead to possible solutions for problems with compression. During the third test, the tool was run at an average of 150 RPM and a maximum of 200 RPM. This produced a frequency quite close to calculations and it was in the range of 20-27 Hz.

The fourth test was on June 29. This time the tool was run at an average of 100 RPM and a maximum of 150 RPM. The tool was run at a set RPM and the compression was adjusted until the tool began to whirl. The observations made in this investigation will be used to solve the compression problem. Once again, frequency and rotational data were taken and the frequencies encountered were anywhere from 13-20 Hz.

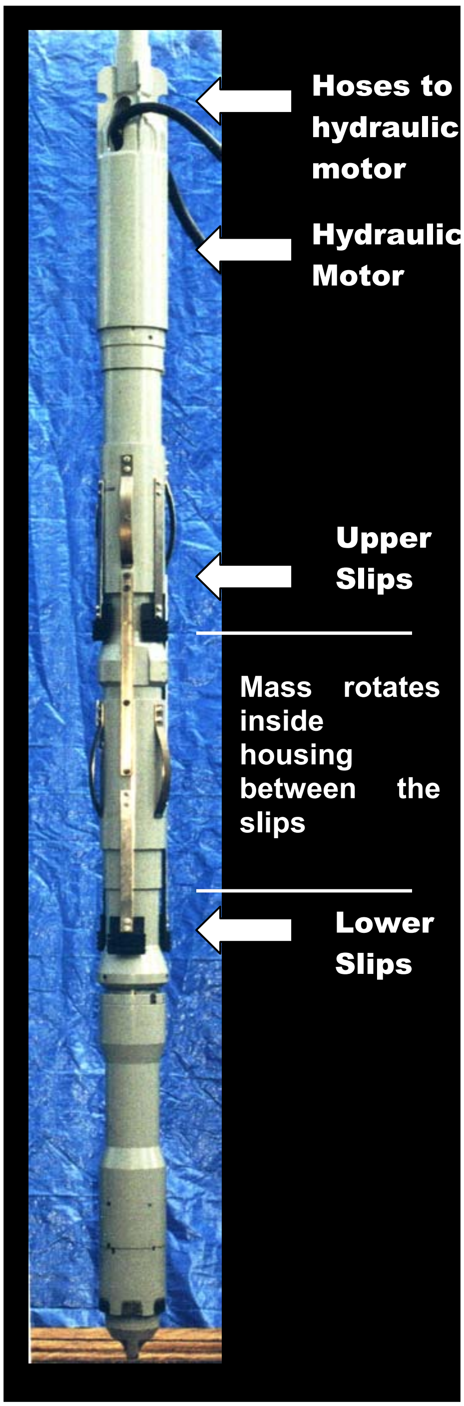
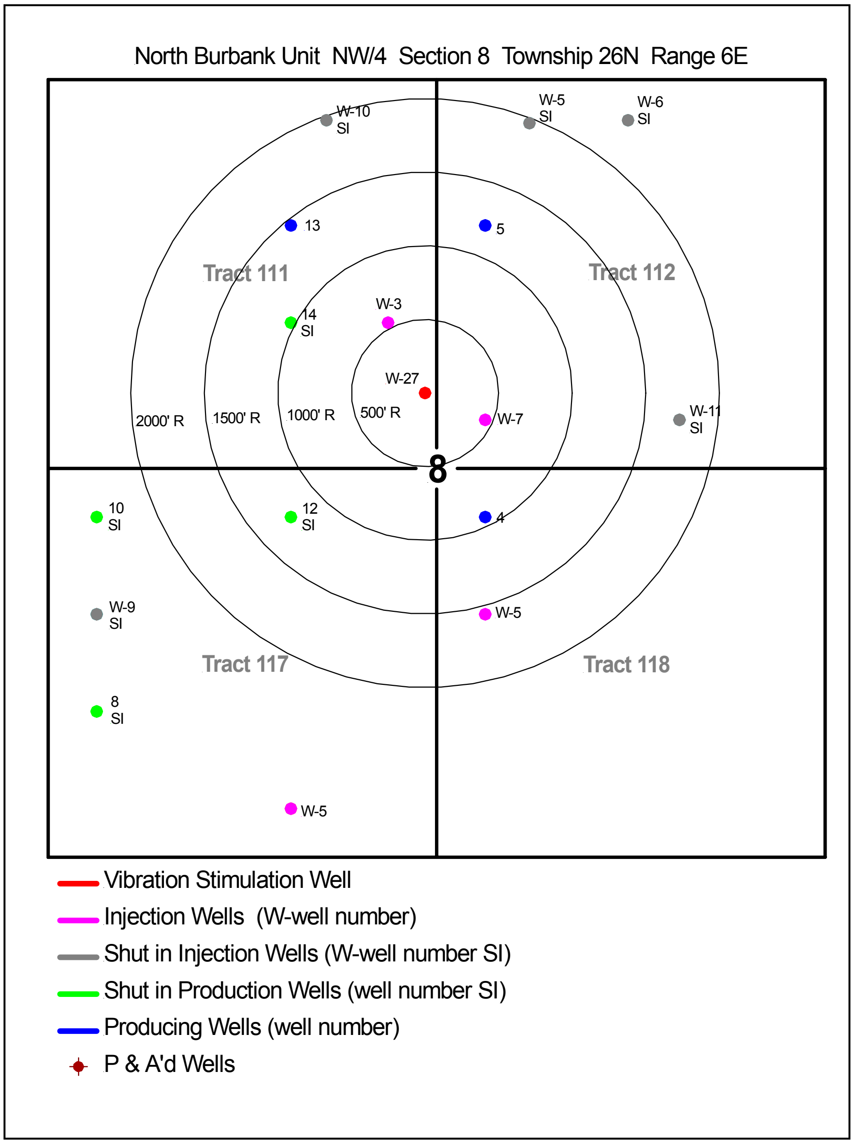


Figure 5 Photo of 7-inch Downhole Vibration Tool

FIELD TESTING

Discussions with both vibration tool providers and individuals from operating companies who have conducted field tests of elastic stimulation have resulted in a framework of how to conduct the field test. In Fig 6 below, the approximate distance from 111-W-27 has been drawn in 500’ radii circles. Calumet Oil Company is monitoring all wells in Section 8 to establish the baseline for production and injection characteristics for each well. The shut-in wells will be candidates for downhole monitoring equipment installation. While not shown on this map, there are many plugged and abandoned wells in each tract, since each tract had sixteen wells.



<u>Figure 6</u> Current Well Locations in Section 8 T26N R6E

Results and Discussion

THIS SECTION OF THE QUARTERLY REPORT REVIEWS IN DETAIL, THE PROGRESS MADE DURING THE QUARTER ON EACH OF THE PROJECT’S MAJOR TASKS AND SUB-TASKS.

TASK 1: DEFINE MOST APPROPRIATE TEST AREA

- *MEET AS TEAM TO REVIEW FIELD PRODUCTION HISTORY AND SCOPE POSSIBLE LOCATIONS.*

The field test location has been moved to the North Burbank Unit (NBU) field, which is operated by Calumet Oil Company. It is the largest field on the Osage Reservation. Calumet Oil Company is currently producing approximately 1200 BOPD and 160,000 BWPD from the NBU. Three meetings have occurred for selecting the pilot test area within the NBU and where to locate the well within the pilot test area.

- *REVIEW WELL LOGS, PRODUCTION RECORDS, ETC. AND DETERMINE A PROPOSED TEST WELL LOCATION*

The screening criteria for selecting the test location have been discussed and agreed upon in first meeting with Calumet on this project. These are follows:

- The area should have good pay thickness (greater than 40’) but low initial production tests (less than 500 bopd IP). These areas should have wells which may not have been flooded as thoroughly as wells with good thickness and high initial production tests.
- The area should be serviced by a single tank battery, this will reduce complications when testing the wells and determining changes in oil production.
- The area should have been under flood with the same pattern for at least one year, this will aid in establishing a solid baseline for production profiles prior to initiating the vibration simulation.

- *MEET TO DEFINE DRILLING LOCATION*

Two meetings were held to discuss the test well location in the NBU. The first was a general review of the entire field operations. Four area met the first criteria listed above, having good pay thickness but low initial production rates. The next meeting reviewed the production equipment facilities, active and inactive wells available, and the time frame of the current injection and production well configuration. This short-listed the potential areas to two sites. Then consideration of electric power accessibility, surface topography and land use allowed for the final selection of Section 8 T26N, R6E, also know as NBU Tracts 111, 112, 117 and 118. Please refer to Figures 3 and 6.

- *Report to Osage Tribal Representatives of project plans*

A presentation of the project status was made at the April 18, 2001 meeting of the Osage Tribal Council. The presentation used much of the material used for the Society of Petroleum Engineers (SPE) Oklahoma City, Production Operations Symposium presentation of SPE Paper 67303.

We were able to announce, for the first time, the switch from the Blazer field to the NBU. Mr. Jack Graves, CEO of Calumet Oil Company, was present to answer questions regarding their participation in the project. Principal Chief Charles O. Tillman was pleased with the effort to find a potentially successful pilot test area, and acknowledged the importance of the test.

TASK 2 DRILL AND CORE TEST WELL

- *SUBMIT AND OBTAIN DRILLING PERMIT*

The drilling permit for the NBU test well has been submitted and approved. The well will be the 111-W-27. It is located, 2560 ft FWL and 510 ft FSL of NW/4 of Section 8, T26N, R6E.

- *BID THE DRILLING RIG AND SERVICES*

Drilling contractors were contacted and bids procured by Calumet Oil Company. Other services such as logging, cementing and material were bid out.

- *AWARD THE DRILLING AND SERVICE CONTRACTS*

Goober Drilling Company was selected to drill the well based on competitive bidding. The expected spud date is mid July 2001.The other related service contracts have been selected based on bidding.

- *PREPARE LOCATION*

Larry F. York of Pawhuska, OK surveyed the location. The location has been built. Since location construction was part of the total drilling contract, a subcontractor for Goober Drilling Company built it.

WORK ON THESE SUBTASKS HAS NOT COMMENCED.

- *DRILL, CORE, AND CASE WELL*
- *REPORT TO OSAGE TRIBAL REPRESENTATIVES OF PROJECT PROGRESS*

TASK 3: DEFINE, CONDUCT & EVALUATE LAB TESTS

- *DEFINE SUITE OF LAB TESTS*

Phillips has conducted numerous lab tests using their sonic core test apparatus. They have observed that cores from different reservoirs as well as different cores from the same reservoir respond at different vibration frequencies. The response is measured when a core is vibrated at the unique frequency. The amount of fluid flowing through the core increases, while holding other variables constant. Detail of the Phillips testing procedures can be found in the Third Quarterly Technical Report for the period January 1, 2001 to March 31, 2001.

- *REVIEW NORTH BURBANK UNIT FIELD CHARACTERISTICS*

Parameter	Value	Units
Area	36.5	sq. miles
Avg. Thickness	53.3	feet
Acre Ft	128,000	Acre feet
Depth	2850	feet
Stock Tank Oil Gravity	39	API Gravity
Reservoir Volume Factor	1.2	reservoir bbls/stock
Original reservoir Pressure	1,200	psia
Original GOR	380	cubic feet/barrel
Temperature	120	degrees Fahrenheit
Viscosity	3.3	centipoise
Produced Water Salinity	85,000	Parts per million
Average Porosity	16.8	percentage
Connate Water Saturation	26	percentage
Average Permeability	50-100	millidarcy

- *REVIEW OF LITERATURE*

There have been numerous articles, papers and bulletins published on the Burbank Sandstone, a major producing formation in western Osage County. Many of the reports were generated as deliverables from DOE sponsored projects. Detail of the various DOE sponsored projects can be found in the Third Quarterly Technical Report for the period January 1, 2001 to March 31, 2001.

- *ANALYZE THE OFFSET CORE*

Phillips completed sonic core tests on several "old" cores in the area of the proposed field tests. "Old" in this sense means cores that were drilled 40 plus years ago and stored in warehouse ambient conditions, with no attempt to preserve the cores. The "old" Bartlesville sandstone cores from near the Blazer field were obtained from the Oklahoma Geological Survey Core and Samples Library in Norman OK. The sonic core test results from the these cores was disappointing, which led to the changing the field for the pilot test.

- *ANALYZE THE PILOT TEST AREA CORE*

While Phillips has conducted several sonic core tests on "old" Burbank cores, the plan to perform sonic core tests on fresh cores is still integral to the project. Plans are in place to take the core recovered from well 111-W-27 and have it tested by the proprietary method developed by Phillips.

WORK ON THESE SUBTASKS HAS NOT COMMENCED

- *EVALUATE LAB TEST RESULTS FOR FREQUENCY AND AMPLITUDE*
- *MEET TO REVIEW LAB TEST RESULTS & BRACKET FIELD TEST FREQUENCIES/AMPLITUDES*
- *REPORT TO OSAGE TRIBAL REPRESENTATIVES ON PROJECT PROGRESS*

TASK 4: DESIGN AND CONSTRUCT DOWN HOLE VIBRATION TOOL AND SURFACE POWER SOURCE

- *FRONT END SOURCE ENGINEERING - SELECT MOST APPROPRIATE POWER SOURCE*

  Sub task completed

- *ENGINEER SOURCES TO SPECIFICATIONS*

  Sub task completed.

- *CONSTRUCT TOOL(S) & SOURCES*

The field test tool was designed to use 'off the shelf' items from downhole tool manufacturers including the slip mechanisms. The 7-inch DHVT has been built to use a hydraulic motor to power the tool at the machine shop. Please refer to Figure 5. The adaptation to powering the tool with rotating sucker rods from the surface is nearly complete.

The surface rod rotating system has been specified and arrangements for leasing this equipment to the project are being discussed, as leasing is not the normal mode of acquiring use of this equipment.

- *SURFACE TEST TOOLS*

The surface testing of the field test tool in conjunction with the power source life testing will be done at one of Calumet’s field locations near the NBU Field.

- *CONDUCT POWER SOURCE LIFE TEST*

Plans are being finalized to conduct the power source life testing of the field test tool and the rod rotating system in one of Calumet’s wells.

- *REPORT TO OSAGE TRIBAL REPRESENTATIVES ON PROJECT PROGRESS*

This sub task has not yet been performed.

TASK 5: INSTRUMENT TEST WELLS

The test well location and adjacent well map has been sent to Ernie Majors, LBNL, and to Peter Roberts, LANL to begin the final planning for the planning for this task. The following sub tasks are in progress:

- *ENGINEER SEISMIC MEASUREMENT SYSTEM*
- *SPECIFY SEISMIC MEASUREMENT SYSTEM*
- *INSTALL SEISMIC MEASUREMENT SYSTEM*

TASK 6: CONDUCT FIELD VIBRATION STIMULATION TESTS

Calumet field personnel have begun collecting both injection and prodcution well information to be able to establish a solid baseline for the wells in Section 8. Injection information is now being gathered daily rather than on the previous bi-weekly schedule. Plans have been made to further isolate the pilot test area wells at tank battery 118, to allow for unambiguous well test information.

A detailed review of both current and plugged and abandoned well files is in progress.

TASK 7: REPORT FIELD TEST RESULTS

WORK ON THIS TASK HAS NOT COMMENCED.

TASK 8: TECHNOLOGY TRANSFER, PUBLICIZE TEST RESULTS

- *WRITE & SUBMIT SPE PAPER ABSTRACT*

  SUB TASK COMPLETED

- *AUTHOR SPE PAPER*

The paper was submitted on January 10, 2001. SPE Paper 67303 “Enhanced Oil Recovery with Downhole Vibration Stimulation” was given at the Production and Operations Symposium (POS) in Oklahoma City, OK on March 27, 2001.

<u>Additional technical presentations made covering work done on this project.</u>

- Presentation of the material from SPE Paper 67303[1] (delivered at the OK City Production Operations Symposium, March 29, 2001) was given at the NPTO Office of the DOE April 19, 2001, at the invitation of Ginny Weyland, contract officer.

- Updated material was presented to the Oklahoma Geologic Survey / DOE Annual Workshop in Oklahoma City May 8,9 2001.

- A presentation was given at the final LANL Seismic Stimulation Project Meeting April 25, 2001, at Berkeley; co-sponsored by Las Alamos National Lab and Lawrence Berkeley National Lab.

- The material was also presented, by invitation, at the Petroleum Technology Transfer Council / Marcus Evans conference on Maximizing Recovery 2001 June 25-26, 2001 in Houston. This was one of four presentations given on seismic stimulation efforts by different organizations given to managers of technology development for operating companies.

- A technical paper abstract has been accepted for the ASME/ETCE conference (Feb 2002) Production Technology Symposium.

- *ESTABLISH A SPE/ DOE/IOR 2002 SYMPOSIUM VIBRATION ENHANCED PRODUCTION WORKSHOP*

A one-day SPE sponsored short course which is planned to cover seismic stimulation efforts around the world, will be offered at the SPE/DOE Thirteenth Symposium on Improved Oil Recovery in Tulsa, OK, April 13-17, 2002.

- *PREPARE VIBRATION ENHANCED PRODUCTION WORKSHOP*

Discussions have transpired concerning coupling a half-day workshop on vibration stimulation in conjunction with other DOE /PTTC sponsored workshops in the midcontinent region. There are no firm plans in place at this time to conduct such workshops.

WORK ON THE SUBTASKS LISTED BELOW HAS NOT COMMENCED.

- *PUBLICIZE VIBRATION ENHANCED PRODUCTION WORKSHOP - PTTC, OIPA, BIA,*
- *CONDUCT BIA, TRIBAL COUNCIL AND OSAGE COUNTY OPERATORS VIBRATION ENHANCED PRODUCTION WORKSHOP DATE TBD*
- *CONDUCT PTTC OK CITY VIBRATION STIMULATION WORKSHOP*
- *CONDUCT PTTC /U OF KANSAS VIBRATION ENHANCED PRODUCTION WORKSHOP DATE TBD*
- *AUTHOR DOE CONFERENCE PRESENTATION DATE TBD*
- *PRESENT DOE CONFERENCE PAPER DATE TBD*
- *PRESENT DOE/BIA CONFERENCE PAPER DATE TBD*

TASK 9: FINISH AND CLOSE OUT PROJECT

WORK ON THIS TASK HAS NOT COMMENCED.

Conclusions

Project Management

No changes to the grant contract have occurred during this reporting period.

Technical Issues

Calumet Oil Company has agreed to participate in the vibration stimulation test at the NBU. A pilot rest area was selected in Section 8 T26N R6E. The vibration stimulation test well location was determined to be 2560 ft FWL and 510 ft FSL of NW/4 of Section 8, T26N, R6E. The drill pad on the location has been built.

The 7-inch Downhole Vibration Tool (DHVT) has been built. It has been shop tested using a hydraulic motor to power it at low operating energy levels.

Goober Drilling Company has been contracted to drill Well 111-W-27 scheduled for mid-July 2001.

Technology Transfer Activities

Presentation of the material from SPE Paper 67303[1] was given at the NPTO Office of the DOE April 19, 2001, at the invitation of Ginny Weyland, contract officer.

Updated material was presented to the Oklahoma Geologic Survey / DOE Annual Workshop in Oklahoma City May 8,9 2001.

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Reference

1. Westermark, R.V. et al.: “Enhanced Oil Recovery with Downhole Vibration Stimulation” SPE 67303 presented in Oklahoma City, OK, March 24-27, 2001

Appendix A

The following is a copy of the invention disclosure letter to the Intellectual Property Law Division, Department of Energy, Chicago Operations Office, dated June 28, 2001.

Other than acknowledgement of receipt, there has been no response received to date regarding this disclosure.

Intellectual Property Law Division June 28, 2001
Department of Energy
Chicago Operations Office
9800 South Cass Avenue
Argonne, IL 60439

RE: Disclosure of Invention Under DOE Grant DE-FG26-00BC15191
“Use of flexshafts in backwards whirling mass vibrator construction”

Dear Sirs,

The purpose of this document is to disclose the invention of the “Use of flexshafts in backwards whirling mass vibrator construction” for work performed under U.S. Department of Energy Grant DE-FG26-00BC15191. The inventor is Robert V. Westermark, Operations Manager for Seismic Recovery LLC, a subsidiary of Oil & Gas Consultants International, Inc.

The purpose of the disclosed invention is to improve the design and operation of the previously patented backwards whirling mass vibrators.

This invention uses two solid shafts to support and rotate the backwards whirling mass within the tool housing. The shafts are designed to be run in compression resulting in flexure. The flexing of the shafts applies a side load to the housing. This side load facilitates starting the mass into a backwards whirling rotational pattern. An additional benefit of the two flexshafts is to ensure the mass’s center of rotation is parallel to that of the housing.

Below in Figure 1(a) and 1(b) are photographs of a prototype tool using the two-flexshaft design, built in September of 2000. The purpose of building the prototype was to test the concept of using two flexshafts to improve starting reliability and for maintaining the center of rotation of the backwards whirling mass parallel to the housing.

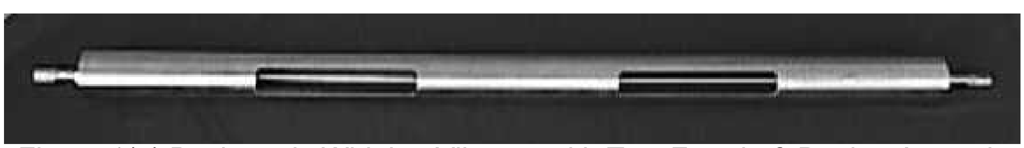


Figure 1(a) Backwards Whirling Vibrator with Two Flexshaft Design Assembled

Figure 1(b) Backwards Whirling Vibrator with Two Flexshaft Design Disassembled. Housing, bearing assemblies, two flexshafts and backwards whirling mass shown.

As background concerning backwards whirling mass vibrators, Oil & Gas Consultants International, Inc. has assigned to its subsidiary, Seismic Recovery the following U. S. patents covering backwards whirling mass vibrators:

USA Patent 5 159 160 “Downhole seismic energy source”.

USA Patent 5 210 381”Apparatus for generating vibrational energy in a borehole”.

USA Patent 5 309 405 “Methods of employing vibrational energy in a borehole”.

USA Patent 5 515 918 “Method of consolidating a slurry in a borehole”.

USA PATENT 5 582 247 “METHODS OF TREATING CONDITIONS IN A BOREHOLE EMPLOYING A BACKWARD WHIRLING MASS”.

As of this date, there has been no publication of manuscript describing the invention, nor sale of the invention, nor public use of the invention. As of this date, there has been no manuscript describing this invention submitted for publication.

The initial notification in writing to the legal firm handling patent issues for Oil & Gas Consultants International, Inc. and Seismic Recovery LLC disclosing the two flexshaft invention for use in a backwards whirling mass vibrator was dated February 12, 2001.

Oil and Gas Consultants International through its subsidiary, Seismic Recovery LLC, has decided to apply for an U.S. patent on May, 1, 2001. Preliminary work for the U.S. patent application has begun.

Concerning questions or clarification, please contact the undersigned at 918 828 2543 in Tulsa OK, or via email at bwestermark@ogci.com.

Respectfully submitted,

_signed original________________________________

Robert V. Westermark

Operations Manager

Seismic Recovery LLC

A Subsidiary of Oil & Gas Consultants International, Inc.

Cc: Virginia Weyland, Contract Officer, NPTO, Tulsa, OK,

Contract Patent Correspondence File

Appendix B

This is the report form Phillips concerning the “old” Bartlesville and “Old” Burbank core responses to their sonic tests

Date: ***5-25-01***

To: ***Bob Westermark***
From: Dan Maloney
Subject: Update on Bartlesville Sandstone Sonic Measurements

Sonic measurements were performed earlier this year on Bartlesville Sandstone cores as practice runs in advance of receiving fresh Blazer Field cores. The Bartlesville Sandstone cores were cut from sections of whole core from an adjacent lease that had been saved (for a good many years). Core plug locations were shown on a previous document. (Appendix B) The plugs were cleaned by alternating cycles of hot toluene and methanol extraction followed by flow cleaning with toluene and methanol.

The coreholder used for sonic tests required core plugs of 5.08-cm diameter and 10-cm length. Plug stacks of 10-cm length were assembled using plug pairs whose appearance on x-ray radiographs suggested similar porosity and mineralogy.

Original intent was to use samples of Blazer oil and brine as test fluids. Samples of these produced fluids were available. These fluids were filtered through 0.45-micron filters to remove sediments.

Plugs 1B and 2B were tested first **(**2214-1 CSO #17w Domes Unit TR#4 1820-1826). The cores were saturated with filtered formation brine. The porosity of the composite core stack was 17%. The permeability of the core to brine was initially measured as 6.9 mD, but decreased by 50% after an overnight period of inactivity. The permeability continued to drop as additional brine was injected. The bottom of the beaker containing brine that had been produced from the core during the previous day was covered with white silt. Although the brine and silt were not analyzed, we suspected that the brine was incompatible with the rock. No further tests were conducted on these plugs.

Plugs 1E and 2E (2214- 4 CSO #17w Domes Unit TR#4 1834.5 – 1836) were tested next. The cores were saturated with filtered formation brine. The porosity of the composite core was 12%. The Elastic Modulus of the brine-saturated core stack was measured as 6.48×10^5 psi. The permeability of the core to brine was 0.2 mD. The permeability of the core to brine was measured while imposing longitudinal vibration (cycles of compression and relaxation) with frequencies from 8 to 2,000 Hz and intensities from 0.0001 to 1 w/m^2. No particular frequency or intensity was found that caused a significant change in permeability. An attempt was made to flood the core to a residual brine saturation condition using filtered Blazer oil (16.1 cP at 76^o F). With 200 psi injection pressure and no back-pressure, scarcely any oil entered the core during a day of injection. Rather than continuing to test these plugs with abnormal pressure gradients, tests on plugs E1 and E2 were discontinued.

As a possible remedy for problems encountered while testing previous plug sets, the test brine was changed to synthetic brine (2% by weight KCl in deionized water).

Plugs 2C and 6C (2214-2 CSO #17w Domes Unit TR#4 1826-1831) were saturated with synthetic brine. The porosity of the composite core stack was 18.7%. The Elastic Modulus of the brine-saturated core was measured as 5.98 x 10^5 psi. The permeability of the core to brine was 18.6 mD. Permeability was continuously measured as the core was subjected to longitudinal vibration with frequencies from 10 to 600 Hz and intensities from $1x10^{-4}$ to 200 w/m^2. Figure 1 shows permeability versus vibration frequency from these measurements. Figure 2 presents permeability versus intensity results. Note that at each frequency, permeabilities were recorded under conditions of different vibration intensity. Figure 3 was constructed to evaluate the combined effects of frequency and intensity on permeability. For frequency and intensity combinations that were not measured, the base permeability of 18.6 mD was used when constructing figure 3. As shown by these figures, although it appears that some permeability enhancement occurred as a result of vibration, permeability enhancement at best was less than 7%.

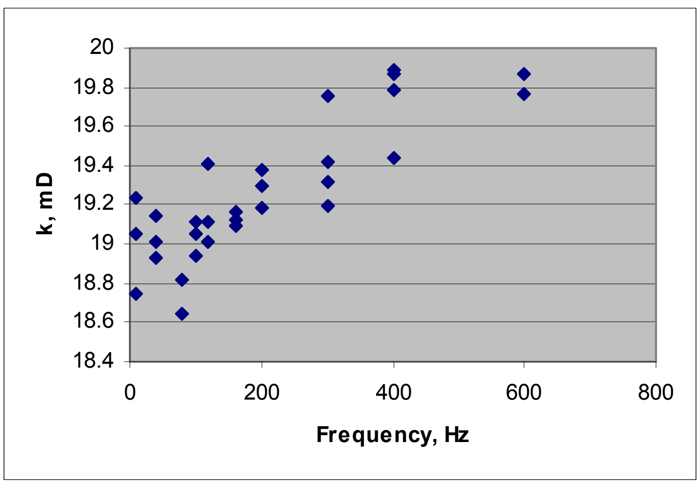


Figure 1. Permeability versus vibration frequency, C cores.

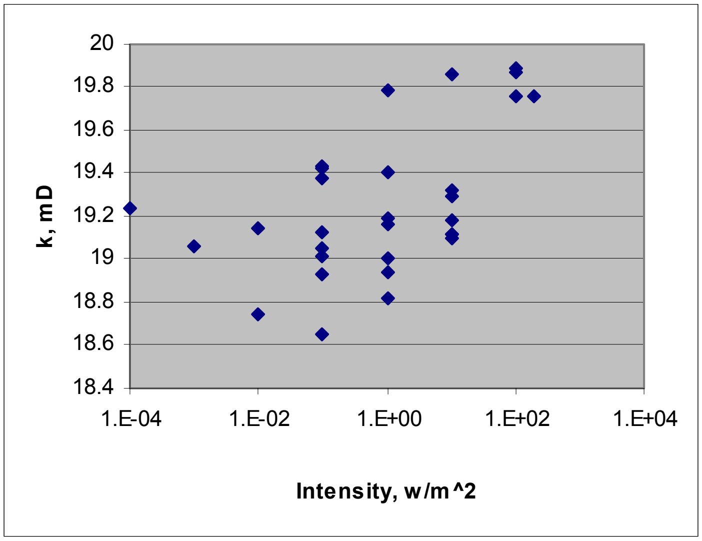


Figure 2. Permeability versus vibration intensity, C cores.

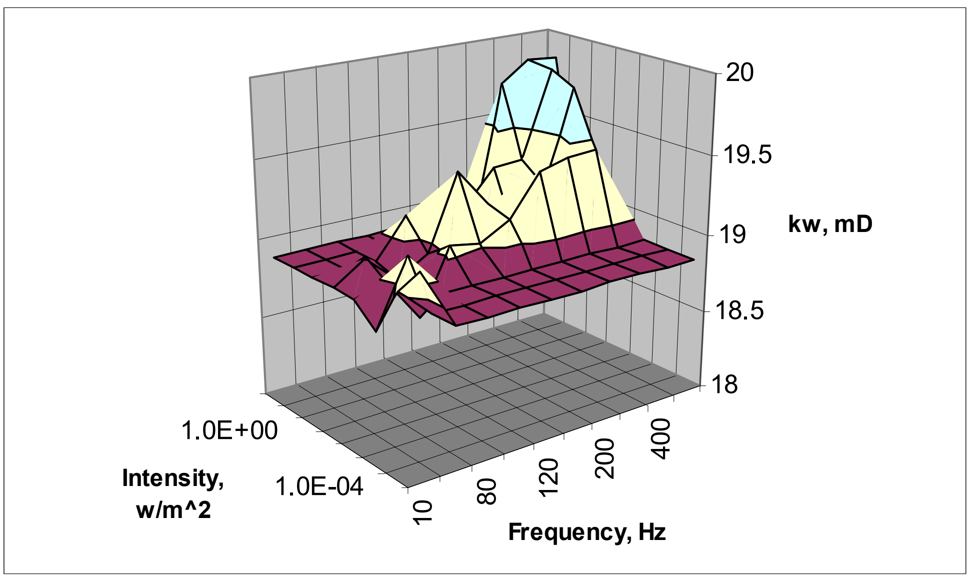


Figure 3. Variation in permeability with vibration frequency and intensity, C cores.

The core was flooded with filtered Blazer oil (16.1 cP at 76^o F) to a residual brine saturation condition (S_{wr} = 24%). The oil permeability at this brine saturation condition was 2.2 mD. Next, the core was waterflooded with a brine injection rate of 0.15 mL/minute. After 1 PV (pore volume) of brine was injected, the water saturation was 53%. No additional oil was produced as an additional 2.8 PV of brine was injected at the same 0.15 mL/minute rate. Thereafter, as brine injection continued, 300 Hz, 10 w/m^2 longitudinal vibration was imposed. No additional oil was produced while an additional 1.3 PV of brine were injected through the core. The final permeabilty of the core to brine was 0.2 mD with S_w = 53%.

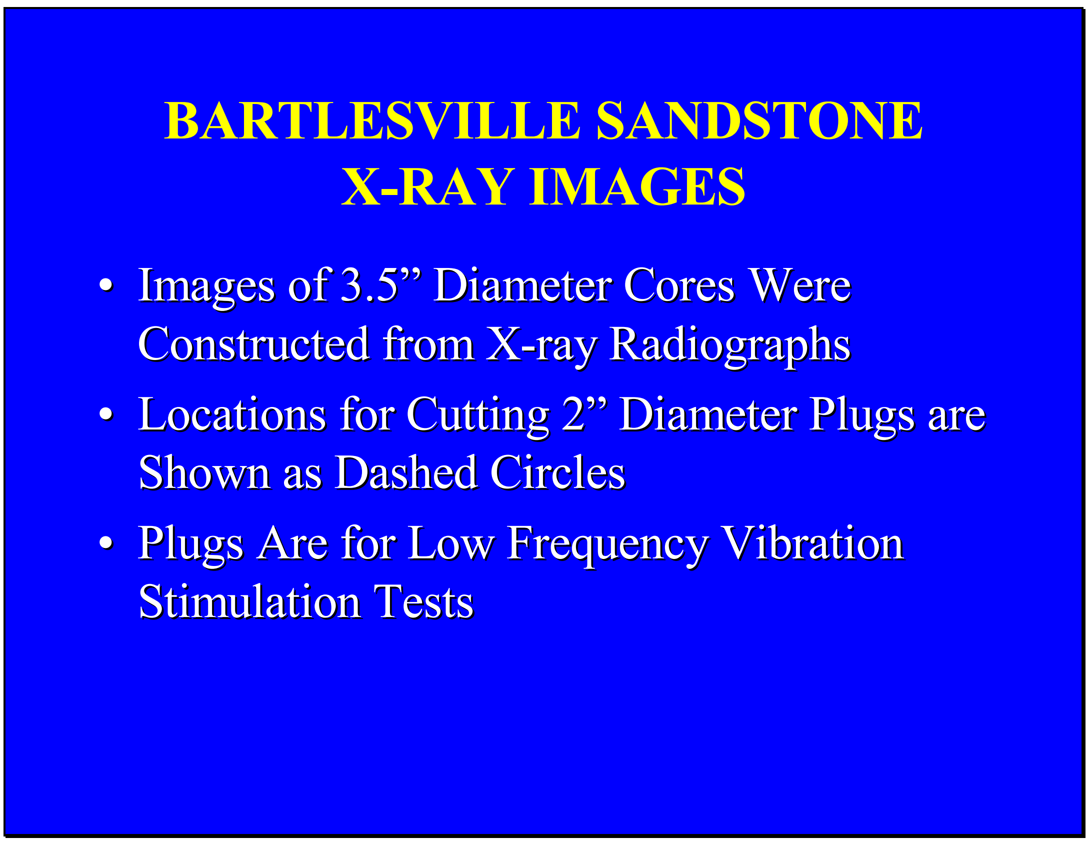
These shakedown tests were considered sufficient to prepare for testing fresh Field cores. A new sonic coreholder was purchased for testing 3.81 cm diameter cores of variable length. The coreholder was designed to facilitate loading and unloading test cores without having to dissassemble the entire coreholder. Slightly higher vibration intensities can be achieved with the same vibration actuator when using 3.81 cm diameter cores compared to 5 cm diameter cores owing to the smaller surface area over which force is applied.

Appendix C

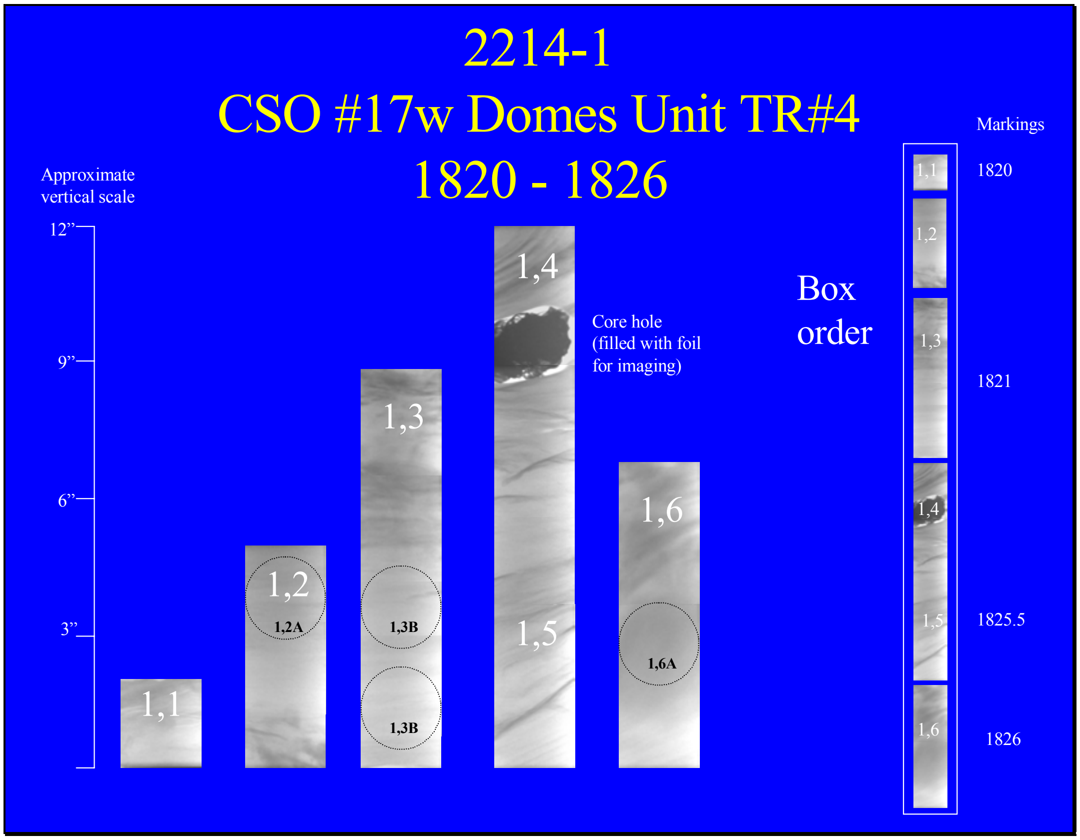
This is the report from Phillips concerning the location of the core plugs taken from the “old” Bartlesville cores obtained from the Oklahoma Geologic Survey.

Date: ***6-12-01***

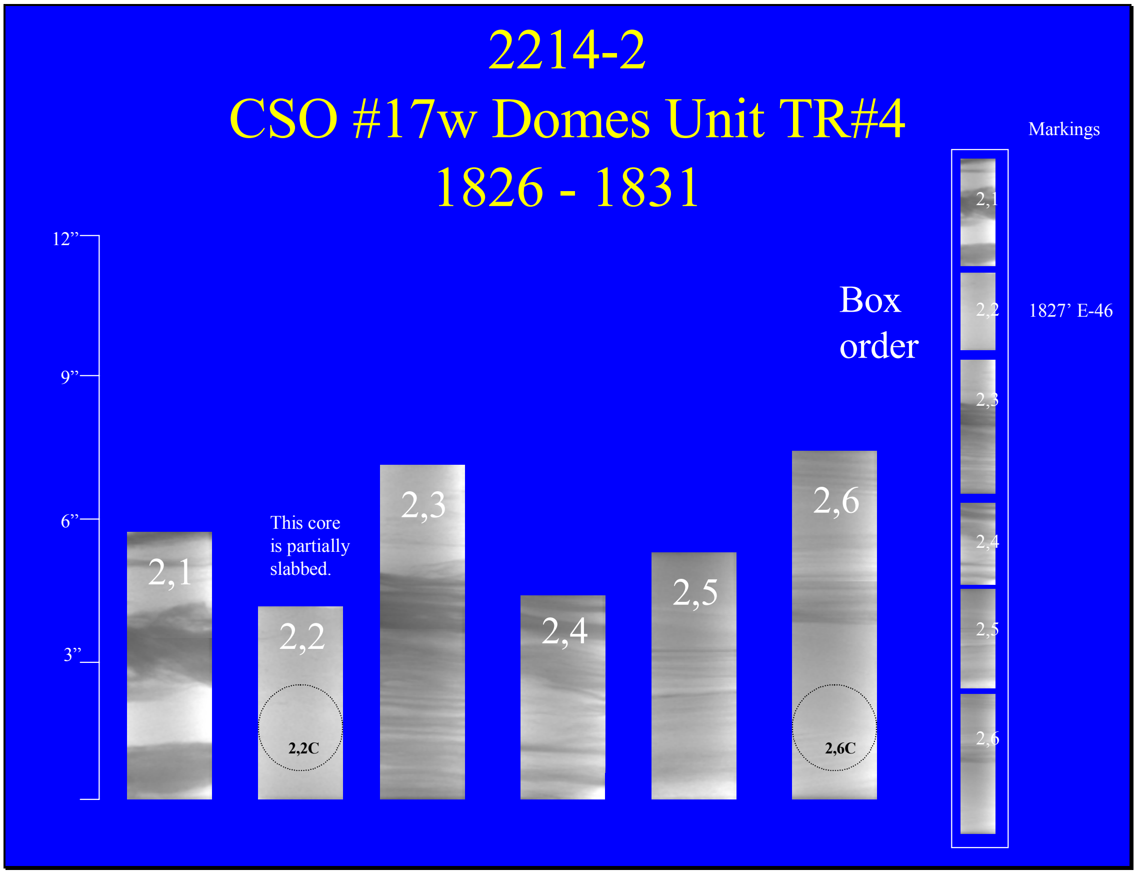
To: ***Bob Westermark***
From: Dan Maloney
Subject: Location of Core Plugs from CSO # 17 W Domes Unit Track #4
Slide 1



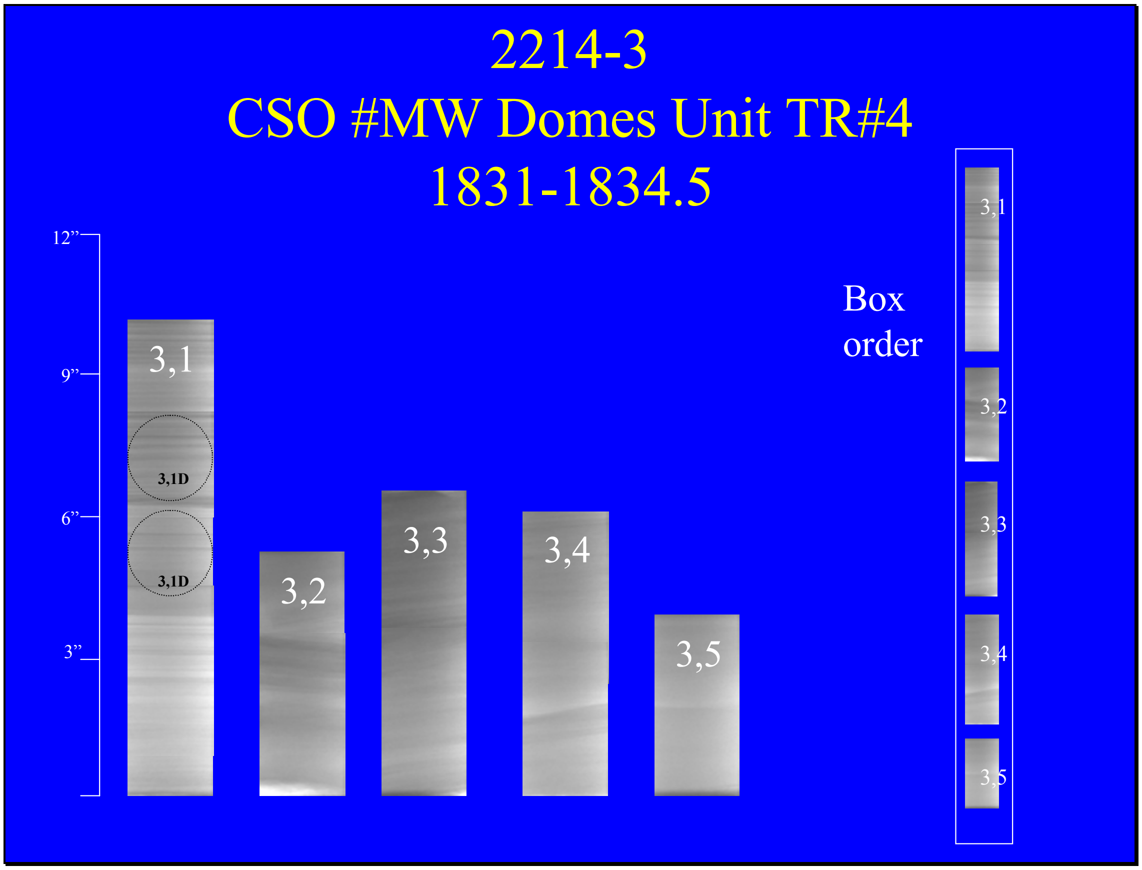
Slide 2


2214-1
CSO #17w Domes Unit TR#4
1820 - 1826
Approximate vertical scale
12"
9"
6"
3"
1,1
1,2
1,2A
1,3
1,3B
1,3B
1,4
1,5
Core hole (filled with foil for imaging)
1,6
1,6A
Box order
Markings
1820
1821
1825.5
1826

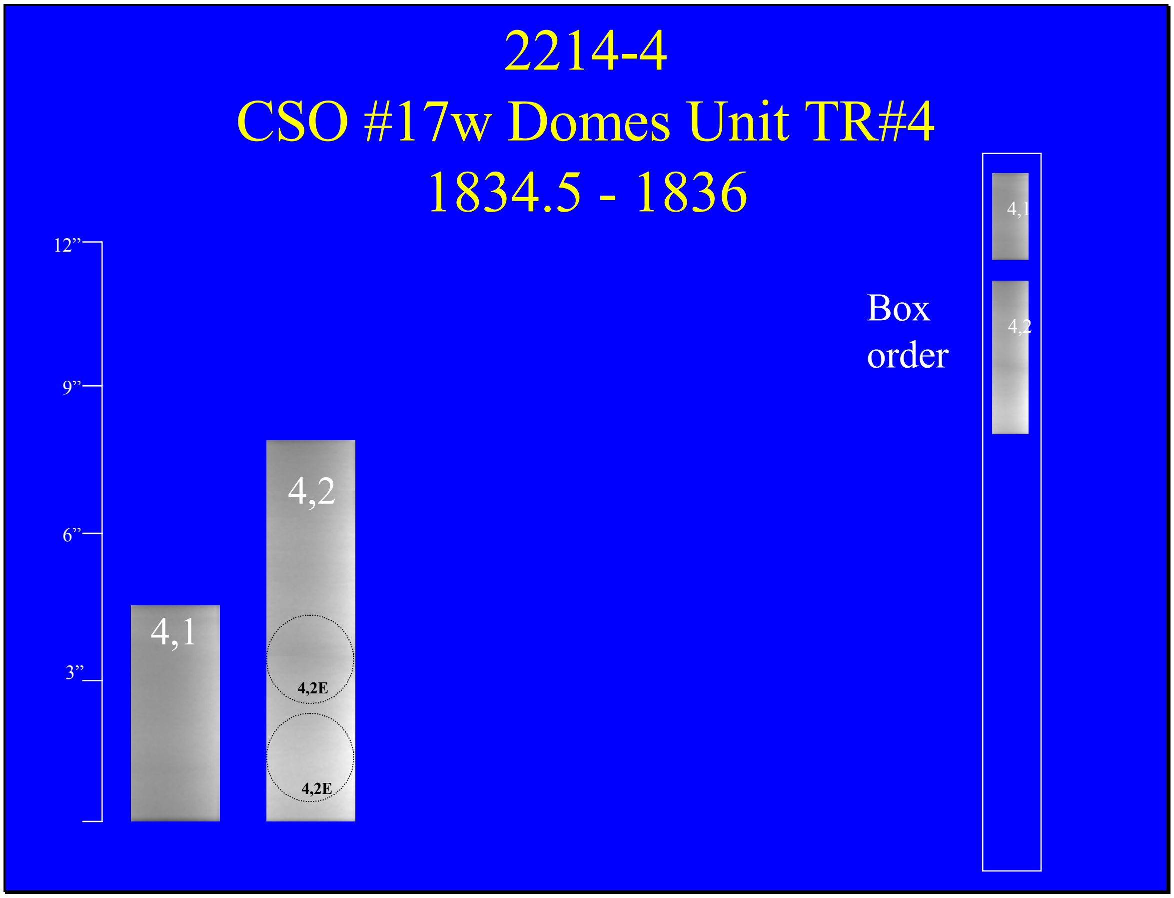
Slide 3


2214-2
CSO #17w Domes Unit TR#4
1826 - 1831
Markings
Box order
1827’ E-46
12”
9”
6”
3”
This core is partially slabbed.
2,1
2,2
2,2C
2,3
2,4
2,5
2,6
2,6C

Slide 4


2214-3
CSO #MW Domes Unit TR#4
1831-1834.5
12"
9"
6"
3"
3,1
3,1D
3,1D
3,2
3,3
3,4
3,5
Box
order
3,1
3,2
3,3
3,4
3,5

Slide 5


2214-4
CSO #17w Domes Unit TR#4
1834.5 - 1836
12"
9"
6"
3"
4,1
4,2
4,2E
4,2E
Box
order
4,1
4,2

Slide 6

Routine Measurements, 3/4” Plugs

As received, grain densities were lower than expected. The plugs were cleaned by methanol extraction. Porosities were measured using helium. Air perms were measured using nitrogen gas and 800 psig confining pressure.

Depth	Grain Density	Porosity	k air
ft.	g/cm^3	Percent	mD
1821	2.71	16.50	2.75
1822	2.67	18.59	32.86
1823	2.65	16.91	18.60
1824	2.65	18.61	22.52
1825	2.70	17.49	8.86
1826	2.70	19.49	24.67
1827	2.65	20.16	43.32
1828	2.73	6.69	0.45
1829	2.73	15.70	3.53
1830	2.77	18.35	11.74
1831	2.79	12.97	1.95
1832	2.72	13.85	1.44
1833	2.67	12.74	0.57
1834	2.71	16.10	2.05